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Scarlet Fever: An Effort in Preventive Medicine.

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THIS paper is an account of an effort in preventive medicine carried out at one of the Royal Naval Training Establishments. It lays no claim to any new research and is merely the account of the application of existing knowledge to an easily controlled community.

H.M.S. "St. Vincent," despite its name, is a shore depôt at Gosport, in the Portsmouth Command. It was formerly the headquarters of a Division of the Royal Marine Light Infantry and was converted to its present use in 1927. It covers a large area, and the buildings, consisting of dormitories, mess rooms, schools and technical instruction rooms, are all well adapted to their purposes. There are ample playing-fields and two swimming baths, so that the place resembles a large public school in its lay-out.

The personnel consists of about 600 boys destined for the seaman branch of the Navy. They join in batches of twenty-five every three weeks, arriving as raw youths from various parts of the country. The age of joining is 15¼, and the average time that a boy spends in the Training Establishment is one year, after which he is drafted to a sea-going ship.

A collection of youths of this age is somewhat explosive material in the matter of the infectious diseases, and the prevention and limitation of these diseases is one of the chief anxieties of any medical officer in charge.

Infectious diseases.—The majority of the infectious diseases, such as measles, mumps, chicken-pox and rubella, do not lend themselves to any specific preventive measures, but much can be done by constant medical inspections, frequent temperature taking, prompt isolation of suspects and contacts, and adequate attention to the periodic cleansing of articles communally used, such as bugles, telepads, and school utensils, to say nothing of those broader measures of hygiene coming under the headings of feeding and ventilation.

With scarlet fever and diphtheria we are on different ground, for we have more specific weapons in the Dick and Schick tests, which enable us to estimate our patients' immunity to these diseases and to take appropriate measures in susceptible cases.

When I took over medical charge of the "St. Vincent" I looked through the records and sick returns, and I found that diphtheria was almost absent, though it had occurred from time to time in another similar establishment in the port; scarlet fever, on the other hand, was persistently present. It seemed to occur every term and to blaze up now again into a small epidemic. A campaign against scarlet fever was therefore evidently desirable, particularly when one remembered its common complications of nephritis, otitis and endocarditis.

The campaign.—As a first step all short leave was stopped for the first three weeks of term so as to isolate the establishment from the outside world. Ordinarily the boys were allowed out on Wednesdays and Saturdays and it seemed probable

that the endemicity of scarlet fever was due to infection acquired at cinemas, theatres, etc. During these three weeks I conducted an intensive search for possible carriers and examined all boys and instructors who had ever had scarlet fever, and on finding a boy who had had the disease shortly before joining and who was suffering from a profuse and unreported discharge from one of his ears, I was filled with hope. I sent him to Haslar for a bacteriological examination and then isolated him pending the result. He was found to be a carrier, but alas, of diphtheria not of scarlet fever! The strain of Klebs-Loeffler bacillus must have been very mild in this case, for we got no cases from him.

The next step was to institute the Dick test as a routine, but as expense would be involved I applied for Admiralty approval. This was given with the proviso that the consent of the boys' parents or guardians should be obtained in all cases. For this purpose I drafted a letter explaining the reason for the Dick test in simple language and requested consent for it to be carried out, together with any subsequent safeguarding procedures which might be found necessary. This correspondence was rather a trouble—and, incidentally, the postage amounted to as much as the cost of the Dick procedures themselves—but I was well repaid by some of the replies. Consent was always given.

It might have seemed rational to test all the boys right away, but it did not appeal to me as a medical procedure as it would have interfered with the work of the establishment, and two or three hundred boys might have required prophylactic inoculation, in which case the occurrence of a number of reactions would have brought disrepute on the whole scheme. As an alternative I tested the boys as they joined in their batches of twenty-five and I estimated that by the end of 1931 all the boys then serving in the establishment would have been tested; this proved correct.

The Dick test.—This consists in the injection into the skin of the forearm of 0·2 c.c. of scarlet fever toxin; it is in the nature of a non-immune phenomenon and indicates whether there is any antibody to the scarlet fever toxin circulating in the blood. It is simple to perform and the only technical faults likely to occur are that the injection may be given hypodermically rather than truly intradermically, or that, owing to the very small quantity required, some of the solution in which the needle of the syringe may have been resting may be injected instead of the toxin. These faults can be easily guarded against. When the injection is made properly a small wheal is raised, exactly like that from a recent mosquito bite.

The result of the test is read in twenty-four hours and a good natural light is advisable. When positive, an area of erythema surrounds the puncture. This erythema is a distinct blush extending for about an inch around the site of injection, and must not be confused with the smaller and more intense redness which sometimes occurs owing to the extravasation of blood immediately in the vicinity of the prick. The makers of the test solutions supply a detoxicated control solution, and they recommend that it should be injected into the other arm to differentiate between the specific reaction due to the scarlet fever toxin and the non-specific "pseudo-reaction" which may occur in individuals susceptible to any foreign protein. This control is not so necessary with the Dick test as with the Schick, and after some experience in reading results it can be dispensed with.

This test enables us to separate those who are immune from those constituting potential cases in any community, and I have found that about 20% of the boys who join the "St. Vincent" give positive Dick reactions and are therefore non-immune to scarlet fever.

The non-immunes are placed on the scarlet fever prophylactic list and are given a course of inoculations intended to produce active immunity.

There are two methods of producing this immunity artificially: (1) The passive, by the injection of one dose of anti-sera, but this only gives about ten days'

immunity. It is very useful when an unexpected case of scarlet fever occurs in a small community such as a ward, but it is of no use for producing the lasting immunity to be aimed at in larger and more permanent communities. (2) The active, in which a course of injections raises the resistance by the production of antibodies.

With scarlet fever vaccine the dosage is by skin test doses; I usually begin the prophylactic course with 500 skin units, and proceed in weekly doses of 1,000, 5,000, and 10,000, so that the course of four injections takes a month. A local reaction in the form of a sore arm is not uncommon, but general reactions are rare in my experience and I have only had four cases, with a total of fourteen days' sickness, in 667 injections.

One satisfactory thing about these prophylactic injections is, that one can prove that one has achieved something, by repeating the Dick test and finding that the reaction has changed from positive to negative. I have not made this a routine, but I have done so in cases selected haphazard at varying times after the prophylactic course in order to discover the duration of the immunity. All remained negative up till eleven months and then, in one case only, there was a slightly positive result again, but it is generally thought that the immunity lasts from eighteen months to two years, though this probably depends to some extent on the amount given during the prophylactic course. The doses I give are on the medium side, but I am satisfied that they are large enough to ensure an immunity for about a year—that is, the time a boy spends in the "St. Vincent"; for, at sea, the chance of his contracting the disease is much lessened.

Up to the end of 1931, 865 boys had been Dick tested, of whom 177 (about 20%) were found to be positive (non-immune). The prophylatic course was given to 168 boys, entailing 667 individual injections.

Cost.—When bought at contract prices and there is no wastage, the Dick test costs a penny per head. The prophylactic course costs about half a crown per head—an insignificant sum compared with the cost of nursing a case of scarlet fever. When the test and prophylactic solutions are purchased at retail prices the above costs are doubled. These solutions do not retain their valency for long, and the Dick solution should be used within a month of issue.

Results.—The immunization of all the boys in the establishment had not been achieved until the end of 1931, and as the figures which I shall give refer to that year, they should not be taken as a final estimate of the efficiency of the measures.

The following two facts, however, are being still further strengthened by my experience during the present year.

(1) The incidence of scarlet fever in the "St. Vincent" for 1931 was 10 per 1,000 as compared with 47·5 per 1,000 for the three previous years that the establishment had been going, and in one of these years the rate was 90 per 1,000; and (2) that scarlet fever is definitely less infectious amongst the boys, and when it does occur is as sporadic cases rather than in small epidemics.

During the summer term of 1930 before anti-scarlet fever measures were taken, there were seven cases—really a small epidemic due to infection from the original case, whilst in the same term in 1931 there were two cases, and as far as I could ascertain, these boys had not been in contact with each other.

As these occurred in the same week, the boys were probably infected from a common source ashore. The interesting feature is that neither case caused any infection of room or class-mates, thus suggesting that the infectivity of the disease had been reduced in an immunized community.

That the "Dick positives" are indeed our potential cases is borne out by an incident which happened towards the end of last year. A boy was found to be positive, but owing to a leave period the prophylactic course was postponed until his return. It was then too late; he contracted the disease ashore and developed it

on the second day of his return; in this case too, however, his messmates were not infected.

Boys who have had scarlet fever invariably give a completely negative Dick test.

What is the relation between these anti-scarlet fever measures and cases of scarlet fever which occurred in 1931?

There were six cases. Two had been recorded as slight or pseudo-reactions and in consequence did not have a prophylactic course. From my experience I now read all doubtful cases as positives, and I am sure this is the best course when preventive measures are at stake.

One case was positive to the Dick test but had not been given a prophylactic course because Admiralty approval had not been received before he contracted the disease.

Two boys had given a negative Dick reaction and logically should not have had the disease. They were probably technical failures in the performance of the test as they occurred early in my series.

One boy was a "positive" and had had a prophylactic course in March. He contracted the disease in an aberrant form in July, and there was some doubt about the diagnosis, but the hospital authorities decided, for safety, to treat the case as one of scarlet fever.

This question as to how far the prophylactic measures modify the diseases when they do appear is still being threshed out in the case of small-pox and vaccination, and I believe also occurs with regard to diphtheria. Unrecognized cases of infectious disease occurring in a susceptible community constitute a serious matter, involving difficult ethical questions about immunizing procedures in general, but it is one which need cause no anxiety when dealing with an immunized community such as that in H.M.S. "St. Vincent" in the case of scarlet fever, for here the definite gain in reduced incidence of the disease and the invaliding therefrom, overbalances other considerations.

Conclusion.—While it may not be possible entirely to purge scarlet fever from amongst a large collection of youngsters living in close proximity, it would appear that its incidence can be lessened, and what is more important still, the disease can be reduced to an almost non-infectious one, as the result of the building up of a communal immunity.

Sporadic cases will undoubtedly occur from time to time, owing to heavy infection or to lowered resistance in the individual; indeed, the Doctors Dick themselves only claim a 95% efficiency for their measure.